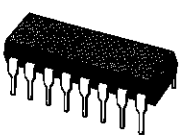
SGS-THOMSON MICROELECTRONICS

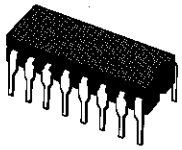
M54HC590
M74HC590

8 BIT BINARY COUNTER REGISTER (3 STATE)

- HIGH SPEED
  f_{MAX} = 62 MHz (TYP.) AT V_{CC} = 5 V
- LOW POWER DISSIPATION
  I_{CC} = 4 μA (MAX.) AT T_A = 25 °C
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (MIN.)
- OUTPUT DRIVE CAPABILITY
  10 LSTTL LOADS (for RCO)
  15 LSTTL LOADS (for QA ~ QH)
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}| = I_{OL}$ = 6 mA (MIN.) FOR QA ~ QH OUTPUT
  $|I_{OH}| = I_{OL}$ = 4 mA (MIN.) FOR RCO OUTPUT
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2 V TO 6 V
- PIN AND FUNCTION COMPATIBLE
  WITH 54/74LS590



B1R
(Plastic Package)



F1R
(Ceramic Package)

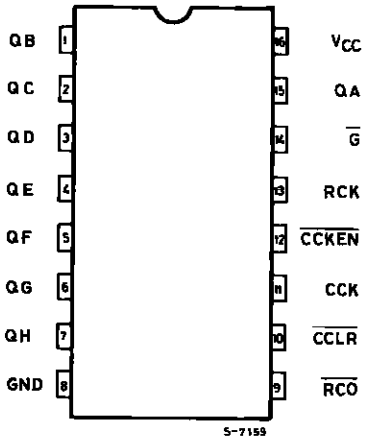
M1R
(Micro Package)

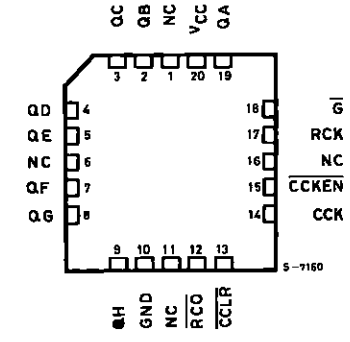
C1R
(Chip Carrier)

ORDER CODES :

M54HC590F1R	M74HC590M1R
M74HC590B1R	M74HC590C1R

PIN CONNECTIONS (top view)





NC =
No Internal
Connection

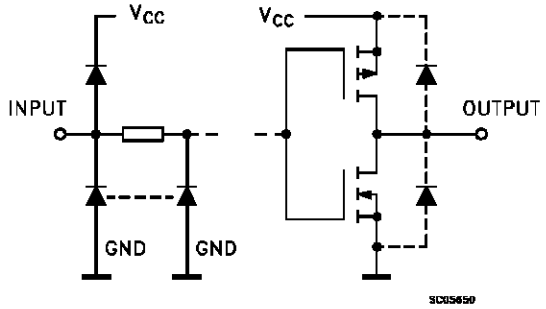
DESCRIPTION

The M54/74HC590 is a high speed CMOS 8-BIT BINARY COUNTER REGISTER (3-STATE) fabricated in silicon gate C^2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

These devices each contain an 8-bit binary counter that feeds an 8-bit storage register. The storage register has parallel outputs. Separate clocks are provided for both the binary counter and storage register. The binary counter features a direct clear input $\overline{CCLR}$ and a count enable input $\overline{CCKEN}$. For cascading, a ripple carry output $\overline{RCO}$ is provided. Expansion is easily accomplished by tying $\overline{RCO}$ of the first stage to $\overline{CCKEN}$ of the second stage, etc. Both the counter and register clocks are positive-edge triggered. If the user wishes to connect both clocks together, the counter state will always be one count ahead of the register. Internal circuitry prevents clocking from the clock enable.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

INPUT AND OUTPUT EQUIVALENT CIRCUIT



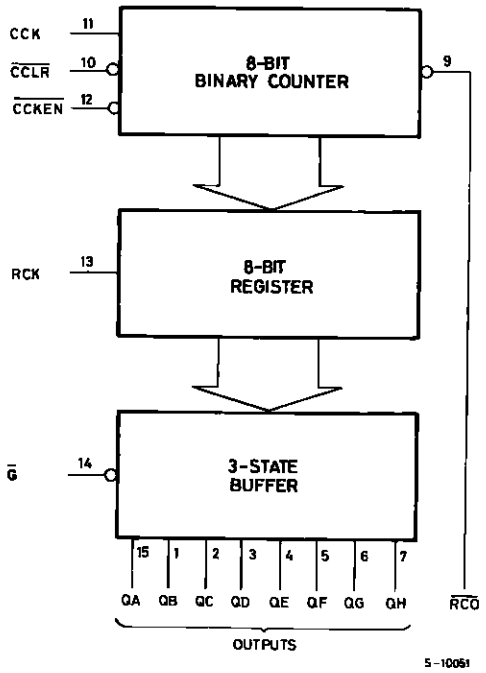
TRUTH TABLE

INPUTS					OUTPUT
$\overline{G}$	RCK	$\overline{CCLR}$	$\overline{CCKEN}$	CCK	
H	X	X	X	X	Q OUTPUTS DISABLE
L	X	X	X	X	Q OUTPUTS ENABLE
X	⎍	X	X	X	COUNTER DATA IS STORED INTO REGISTER
X	⎏	X	X	X	REGISTER STATE IS NOT CHANGED
X	X	L	X	X	COUNTER CLEAR
X	X	H	L	⎍	ADVANCE ONE COUNT
X	X	H	L	⎏	NO COUNT
X	X	H	H	X	NO COUNT

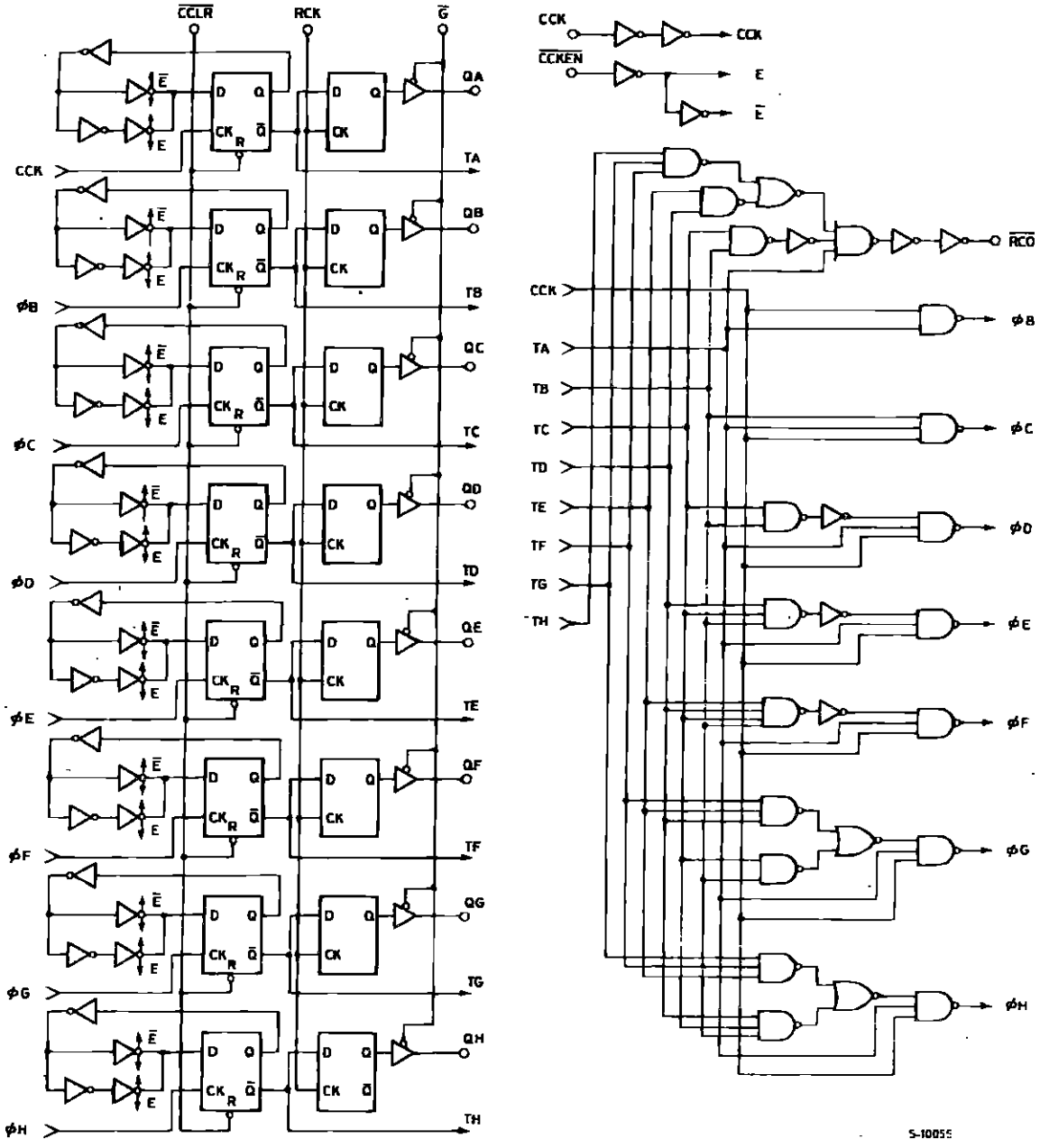
X: DON'T CARE

$\overline{RCO} = \overline{QA' \bullet QB' \bullet QC' \bullet QD' \bullet QE' \bullet QF' \bullet QG' \bullet QH'}$ (QA' to QH': INTERNAL OUTPUTS OF THE COUNTER)

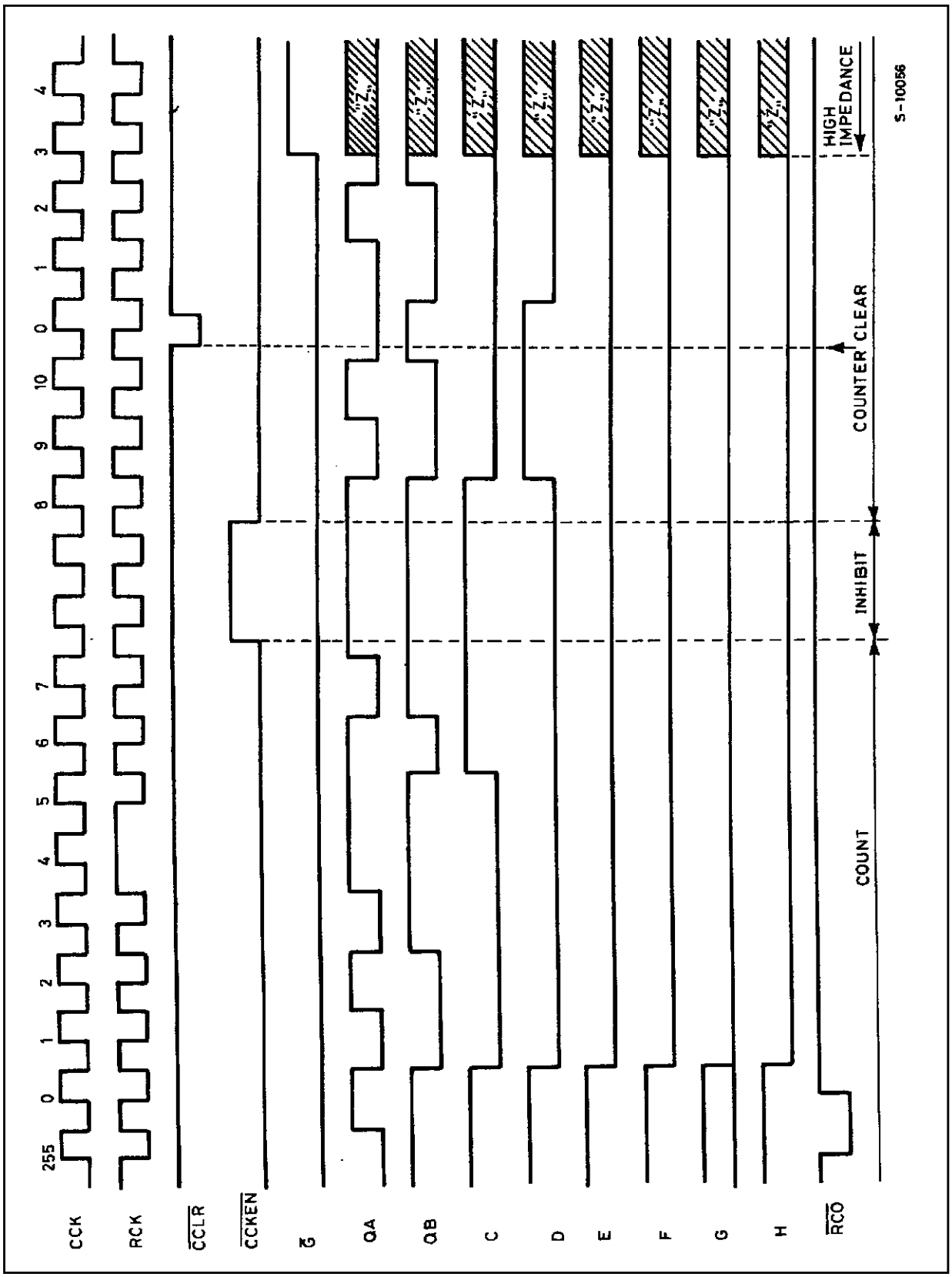
LOGIC DIAGRAM



LOGIC DIAGRAM



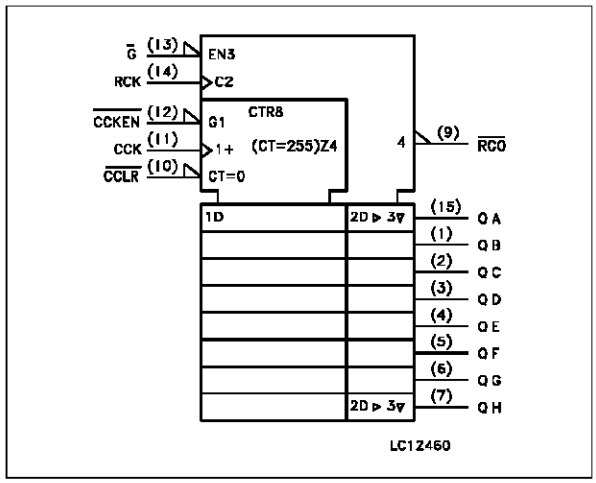
TIMING CHART



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 15	QA to QH	Outputs
11	CCK	Counter Clock Input
12	$\overline{CCKEN}$	Counter Clock Enable Input
13	RCK	Register Clock Input
9	$\overline{RCO}$	Ripple Carry Output
14	G	Output Enable Input
10	$\overline{CCLR}$	Counter Clear Input
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

IEC LOGIC SYMBOL



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_I	DC Input Voltage	-0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin (RCO) (Q_A - Q_H)	± 25 ± 35	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
(*) 500 mW: ≅ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 6	V
V_I	Input Voltage		0 to V_{CC}	V
V_O	Output Voltage		0 to V_{CC}	V
T_{op}	Operating Temperature: **M54HC** Series **M74HC** Series		-55 to +125 -40 to +85	°C °C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2 V	0 to 1000	ns
		V_{CC} = 4.5 V	0 to 500	
		V_{CC} = 6 V	0 to 400	

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)			T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
V_{IL}	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
V_{OH}	High Level Output Voltage (for RCO output)	2.0	V_I = V_{IH} or V_{IL}	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		
		4.5		I_O=-4.0 mA	4.18	4.31		4.13		4.10		
		6.0		I_O=-5.2 mA	5.68	5.8		5.63		5.60		
V_{OH}	High Level Output Voltage (for QA to QH outputs)	2.0	V_I = V_{IH} or V_{IL}	I_O=-20 µA	1.9	2.0		1.9		1.9		V
		4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		
		4.5		I_O=-6.0 mA	4.18	4.31		4.13		4.10		
		6.0		I_O=-7.8 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low Level Output Voltage (for $\overline{RCO}$ output)	2.0	V_I = V_{IH} or V_{IL}	I_O= 20 µA		0.0	0.1		0.1		0.1	V
		4.5				0.0	0.1		0.1		0.1	
		6.0				0.0	0.1		0.1		0.1	
		4.5		I_O= 4.0 mA		0.17	0.26		0.33		0.40	
		6.0		I_O= 5.2 mA		0.18	0.26		0.33		0.40	
V_{OL}	Low Level Output Voltage (for QA to QH outputs)	2.0	V_I = V_{IH} or V_{IL}	I_O= 20 µA		0.0	0.1		0.1		0.1	V
		4.5				0.0	0.1		0.1		0.1	
		6.0				0.0	0.1		0.1		0.1	
		4.5		I_O= 6.0 mA		0.17	0.26		0.33		0.40	
		6.0		I_O= 7.8 mA		0.18	0.26		0.33		0.40	
I_I	Input Leakage Current	6.0	V_I = V_{CC} or GND				±0.1		±1		±1	µA
I_{OZ}	3 State Output Off State Current	6.0	V_O = V_{CC} or GND				±0.5		±5		±10	µA
I_{CC}	Quiescent Supply Current	6.0	V_I = V_{CC} or GND				4		40		80	µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6 ns)

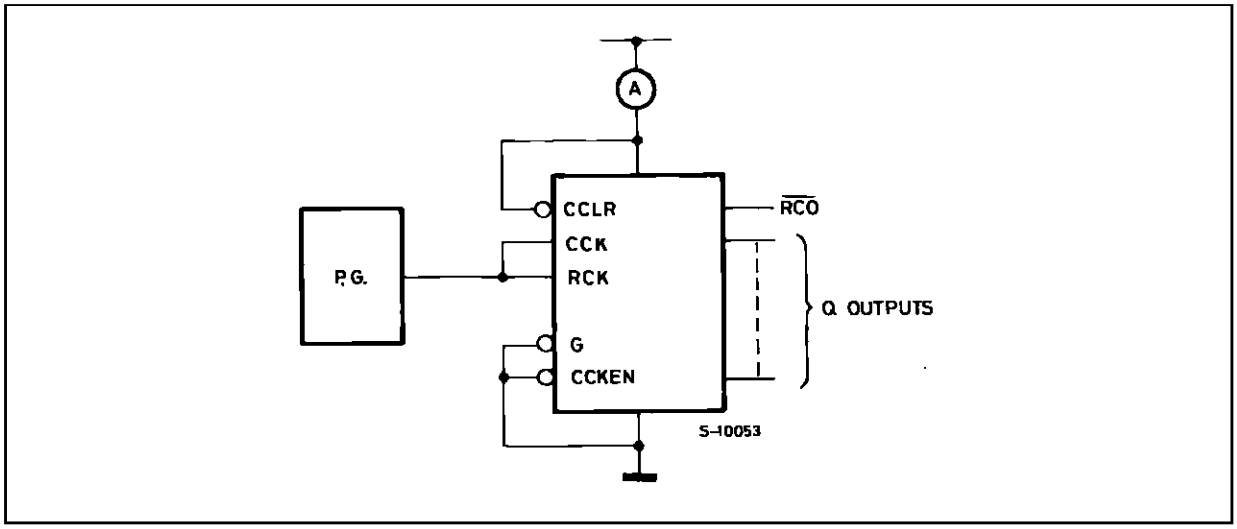
Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time (Qn)	2.0	50			25	60		75		90	ns
		4.5				7	12		15		18	
		6.0				6	10		13		15	
t_{TLH} t_{THL}	Output Transition Time ($\overline{RCO}$)	2.0	50			30	75		95		115	ns
		4.5				8	15		19		23	
		6.0				7	13		16		20	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CCK}$ - RCO)	2.0	50			56	165		205		250	ns
		4.5				19	33		41		50	
		6.0				16	28		35		43	
t_{PLH}	Propagation Delay Time ($\overline{CCLR}$ - RCO)	2.0	50			53	175		220		265	ns
		4.5				21	35		44		53	
		6.0				18	30		37		45	
t_{PLH} t_{PHL}	Propagation Delay Time (RCK - Q)	2.0	50			48	145		180		220	ns
		4.5				17	29		36		44	
		6.0				14	25		31		37	
		2.0	150			60	185		230		280	ns
		4.5				21	37		46		56	
		6.0				18	31		39		48	
t_{PZL} t_{PZH}	Output Enable Time	2.0	50	R_L = 1 KΩ		39	105		130		160	ns
		4.5				13	21		26		32	
		6.0				11	18		22		27	
		2.0	150	R_L = 1 KΩ		51	135		170		205	ns
		4.5				17	27		34		41	
		0				14	23		29		35	
t_{PLZ} t_{PHZ}	Output Disable Time	2.0	50	R_L = 1 KΩ		28	105		130		160	ns
		4.5				14	21		26		32	
		6.0				12	18		22		27	
f_{MAX}	Maximum Clock Frequency	2.0	50		6.6	13		5.2		4.4		ns
		4.5			33	52		26		22		
		6.0			39	61		31		26		
$t_{W(L)}$ $t_{W(H)}$	Minimum Pulse Width ($\overline{CCK}$, RCK)	2.0	50			36	100		125		145	ns
		4.5				9	20		25		29	
		6.0				8	17		21		25	
$t_{W(L)}$	Minimum Pulse Width ($\overline{CCLR}$)	2.0	50			32	75		95		110	ns
		4.5				8	15		19		22	
		6.0				7	13		16		19	
t_s	Minimum Set-up Time ($\overline{CCKEN}$ - $\overline{CCK}$)	2.0	50			44	100		125		150	ns
		4.5				11	20		25		30	
		6.0				9	17		21		26	

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6 ns)

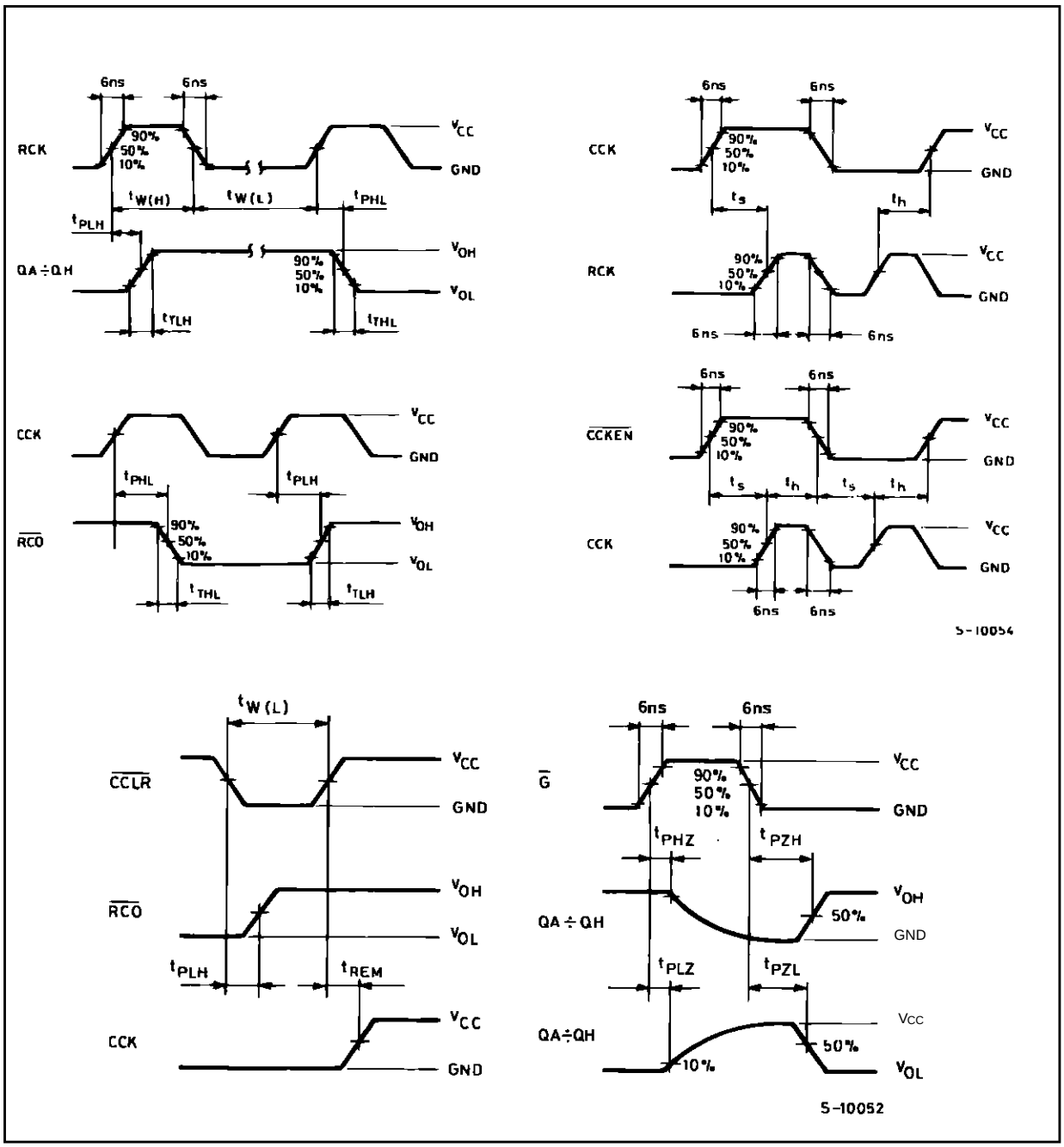
Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		T_A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
$t_{s(H)}$	Minimum Set-up Time (CCK - RCK)	2.0	50			76	175		220		255	ns
		4.5				19	35		44		51	
		6.0				16	30		37		43	
t_h	Minimum Hold Time	2.0	50				0		0		0	ns
		4.5					0		0		0	
		6.0					0		0		0	
t_{REM}	Minimum Hold Time $\overline{(CCLR)}$	2.0	50			28	75		95		110	ns
		4.5				7	15		19		22	
		6.0				6	13		16		19	
C_{IN}	Input Capacitance					5	10		10		10	pF
C_{PD} (*)	Power Dissipation Capacitance					40						pF

(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

TEST WAVEFORM I_{CC} (Opr.)

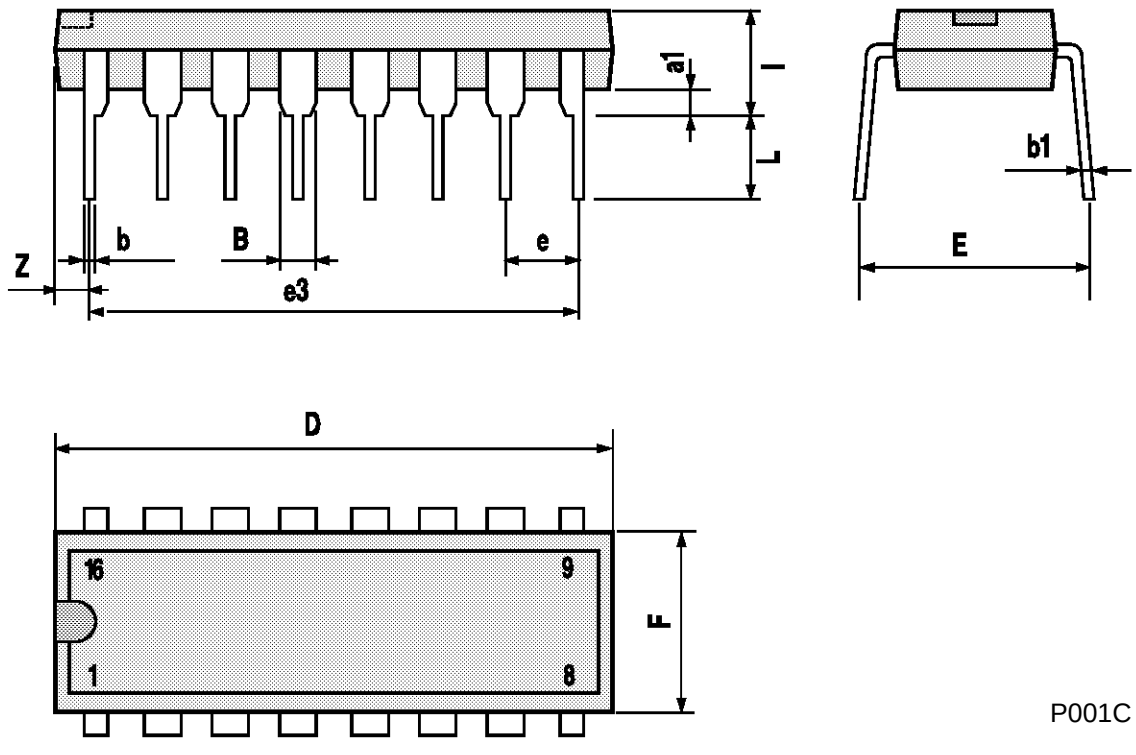


SWITCHING CHARACTERISTICS TEST WAVEFORM



Plastic DIP16 (0.25) MECHANICAL DATA

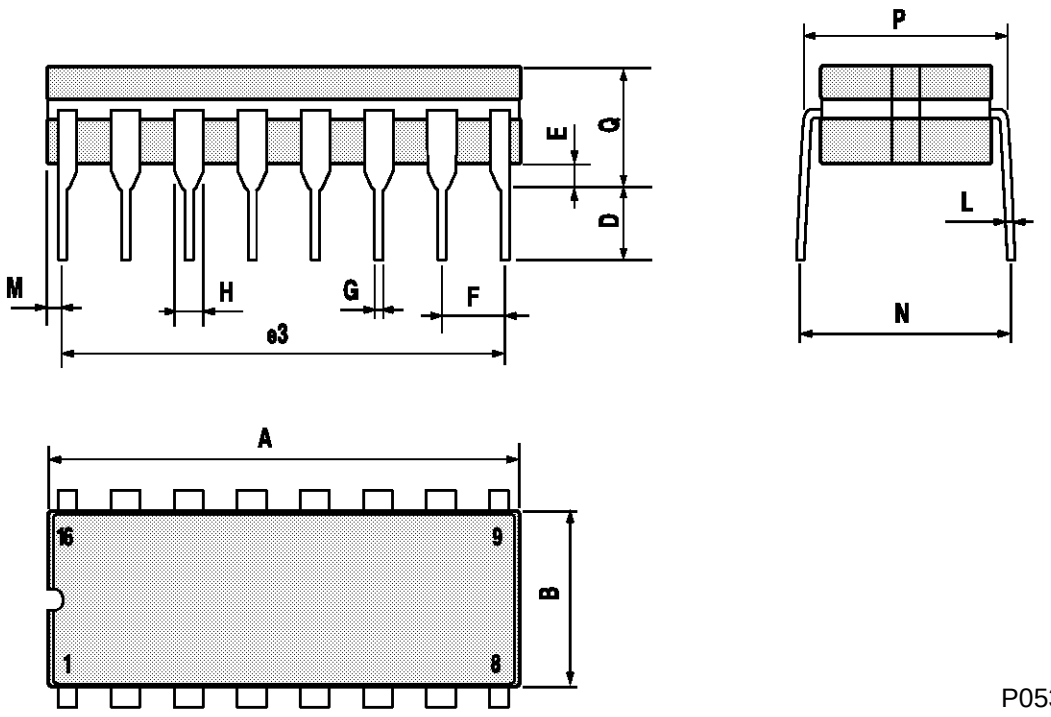
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

Ceramic DIP16/1 MECHANICAL DATA

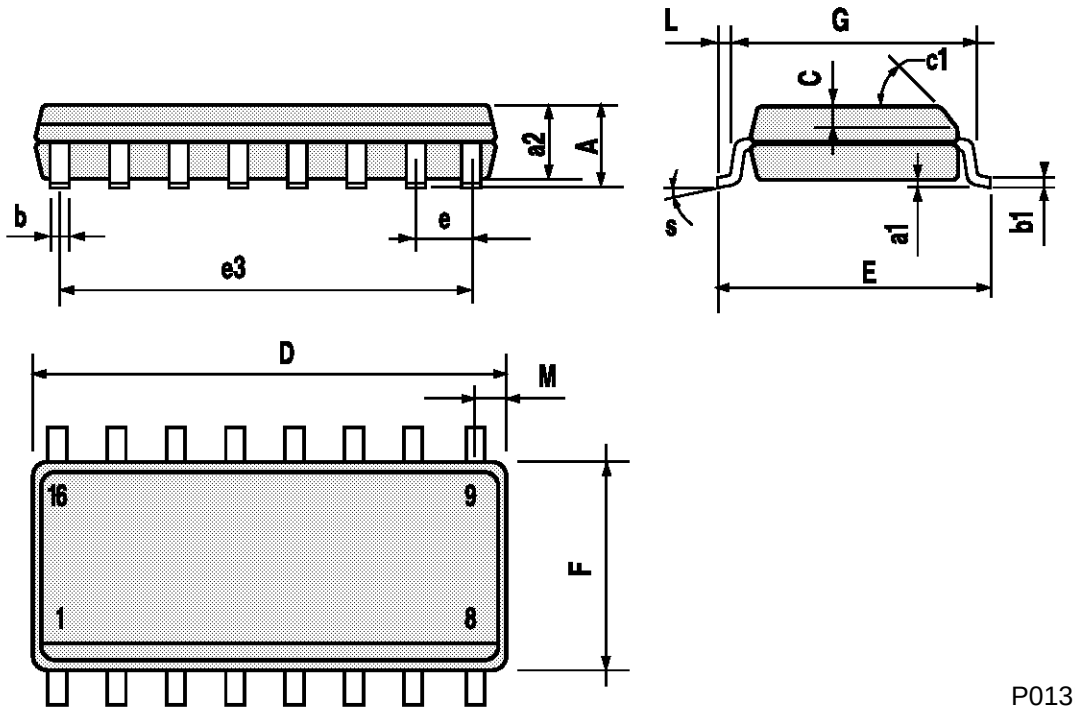
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053D

SO16 (Narrow) MECHANICAL DATA

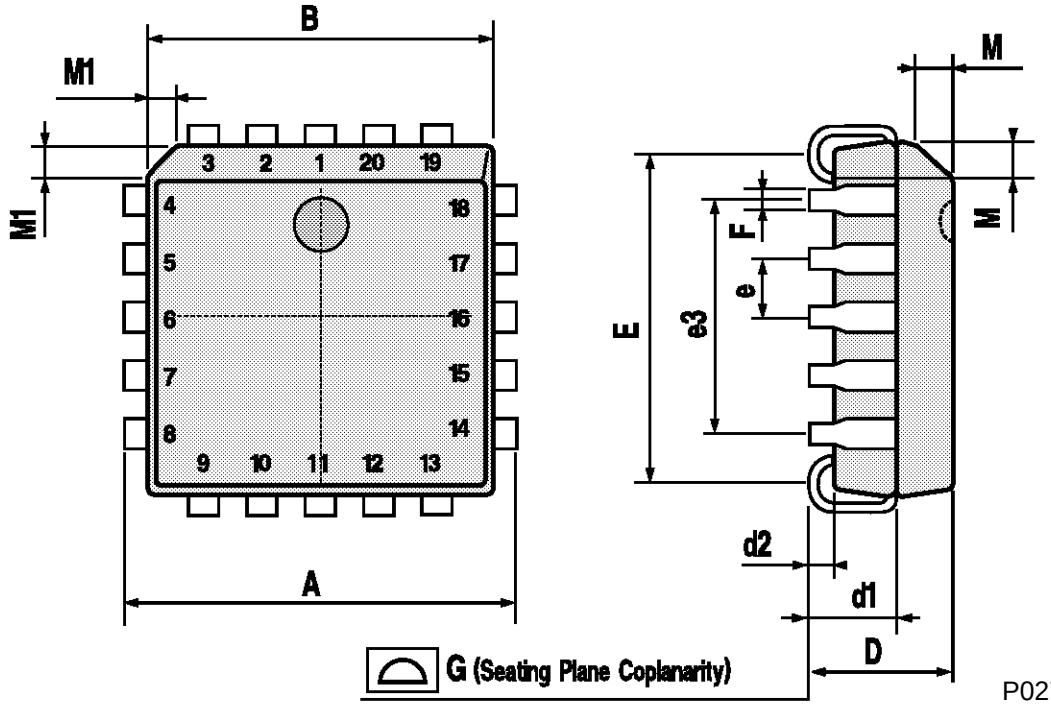
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



P027A

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